Attachment A

Supplemental Comments on EPA's Proposed Rule Revisions

Docket EPA-HQ-OAR-2006-0888
Prevention of Significant Deterioration New Source Review:
Refinement of Increment Modeling Procedures

September 28, 2007

This document contains supplemental technical comments by the State of North Dakota, North Dakota Department of Health (hereafter Department, we or our), on EPA's proposed refinements to the CAA New Source Review Program and the program's Prevention of Significant Deterioration measures. These comments supplement comments in the letter to which this document is attached.

Some comments filed in the docket for this proposed rule making (EPA-HQ–OAR-2006-0888) advocated using maximum or peak (i.e., near, but less than, maximum) short-term emission rates when modeling (1) for short-term cumulative ambient concentrations that are used for NAAQS compliance assessments or AQRV impact assessments and (2) for short-term cumulative changes in concentrations that are used for PSD increment-consumption assessments. [1,2] In the first instance, an inventory of current-period (a.k.a. current-time) emissions is needed as input for the modeling. And in the second instance, an inventory of current-period and an inventory of baseline emissions are needed. The difference between current-period and baseline emissions is often referred to as increment-affecting emissions.

In its initial comments, the Department supported the proposed new definition for "actual emissions", including the proposed policy standard that emissions data in modeling are reliable, consistent and representative which embraces professional judgment in use of emissions data as input to air quality models.

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[1] See docket EPA-HQ-OAR-2006-088 documents: 1) 0614 by the Dakota Resource Council, et al., section III through IX; 2) 0594.9 by Jana B. Milford pages 4 through 20; 3) 0594.12 by the US Department of the Interior, pages 7 and 8; 4) 0587.2 by the New York State Department of Environmental Conservation, pages 16 through 27; and 5) 1195 by the US Department of the Interior, pages 4 and 5.

[2] If deference is given by EPA to these comments in an adoption of refinements to PSD increment consumption modeling, the outcome could conceivably have a far reaching impact on the modeling. For example, state and local agency reviewing authorities have used a wide variety of representations of sources' current-period and baseline emissions. (See docket document EPA-HQ-OAR-2006-0888-587.4 titled PSD Questionnaire Summary dated May 16, 2005.)

In these supplemental comments, the Department provides additional analysis of CEM sulfur dioxide emissions of the thirteen operating electric generating units (EGUs) located in North Dakota. Three aspects of the CEM emissions data are emphasized here:

(1) The operating permits granted by the Department for two electric generating stations (EGSs) contain a provision that sets a bubble emissions limit for the two EGUs at each respective EGS. The bubble emissions limits must be included in calculation of maximum or peak short-term emissions rates.

(2) CEM data include emissions during an EGU's start-up, shutdown and malfunctions. These analyses illustrate with a fact-specific example why flexibility and judgment in calculation of maximum or peak short-term emissions rates is necessary.

(3) In PSD increment modeling, modeled emission rates should represent (a) the rates at which pollutants are actually emitted and concentrations actually monitored rather than (b) the potential worst-case rates without regard to concentrations actually monitored.

1. Some North Dakota permits included bubbled emission limits.

The operating permit for the Basin Electric Cooperative – Antelope Valley Station sets a combined, or bubble, sulfur dioxide emission limit of 3,845 pounds per hour rolling three-hour average for Units 1 and 2. And the operating permit for the Great River Energy – Stanton Station sets a combined sulfur dioxide emission limit of 5,785 pounds per hour rolling three-hour average for Units 1 and 10. In other words, the permit constrains the operations of the station so that the sum of emissions of the two units does not exceed the bubble limit of the permit; i.e., when one unit's emissions are high the other unit's emissions must be low to avoid excess emissions.

CEM systems collect sulfur dioxide emissions data for each EGU, and CEM hourly emissions data are contained in EPA's Acid Rain Program emissions data system. Maximum or peak emissions can be extracted from the CEM data for each respective EGU; but the maximum or peak emissions of the two EGUs at the Antelope Valley Station or at the GRE Stanton Station do not occur at the same time (in synchrony) due to permit constraints. So current-period maximum or peak emissions for these two stations used in air quality assessments must be determined by another method.

In this illustration, maximum emissions for each EGU were selected as the highest (H) of 5,848 3-hour or 731 24-hour block averages of hourly CEM sulfur dioxide emissions for each of the thirteen EGUs. Alternatively, maximum emissions for the Antelope Valley Station and the GRE-Stanton Station were selected as the H of the 3-hour and the 24-hour block averages of the EGS's concurrent EGU sulfur dioxide emissions so as to reflect the constraint on operations by the permit bubble limit.

The maximum emission results are shown in figures 1 (page 15) and 2 (page 16) attached. Figure 1 includes the January through February period during year 2000 and figure 2 includes the entire 24-month period during years 2000 and 2001. Each figure has ten line graphs or plots of data:

"plot c" at 64,339 pounds per hour (lb/hr) is the sum of maximum 3-hour rolling average sulfur dioxide emissions allowed by operating permits for the EGS; the permits do not include 24-hour emission limits.

"plot i" is the sum of CEM sulfur dioxide emissions by all thirteen EGUs for each hour during the two months or during the 24 months.

"plot h" at 38,472.5 lb/hr is the sum of sulfur dioxide rule-defined "actual emissions" as used by the Department in its State and EPA MOU Protocol.

"plot g" at 47,344 lb/hr is the sum of 90th percentile of daily averaged CEM sulfur dioxide emissions for each EGU as used by EPA Region 8 in its draft 2003 modeling.

"plot f" at 49,832.9 lb/hr is the highest sum of CEM hourly sulfur dioxide emissions by all thirteen EGUs among all 17,544 hours during years 2000-01.

"plot a" at 79,246.7 lb/hr is the sum of the H 3-hour block averaged CEM sulfur dioxide emissions for the thirteen EGUs.

"plot b" at 72,678.9 lb/hr is an adjusted sum H 3-hour block averaged CEM sulfur dioxide emissions that bubbles EGUs at the Antelope Valley Station and the GRE Stanton Station.

"plot d" at 61,050.1 lb/hr is the sum of the H 24-hour block averaged CEM sulfur dioxide emissions for the thirteen EGUs.

"plot e" at 57,173.3 lb/hr is an adjusted sum H 24-hour block averaged CEM sulfur dioxide emissions that bubbles EGUs at the Antelope Valley Station and the GRE Stanton Station.

The sums of EGU or EGS/EGU current-period (2000-01) maximum emissions rates in plots a through h are represented as lines in figures 1 and 2 because the rates would be/were modeled for each hour of meteorology throughout the two months or two years. Figures 1 and 2 illustrate that:

(1) Sulfur dioxide actually emitted is substantially less than permit allowed 3-hour rolling averages (compare plot i to line plot c).

(2) Since the sum of EGU hourly CEM emissions (line plot i) is substantially less that the sum of H 3-hour and H 24-hour block averaged EGU emissions occurring at anytime during years 2000-01 (line plots a and d), the H 3-hour and H 24-hour

block averaged EGU emissions of respective EGUs never occurred at the same time (compare plot i to plots a and d). [3]

(3) Modeling time-constant sulfur dioxide peak emissions calculated from CEM data for each respective EGUs at the two bubble-constrained EGS (compare plot b to plot a and compare plot e to plot d) would overestimate ambient sulfur dioxide concentrations and impacts on AQRVs assuming meteorological and dispersion models are robust (reasonably accurate).

(4) Modeling time-constant sulfur dioxide emissions (such as line plots a, b, c, b', d and e) that are larger than the highest sum of CEM sulfur dioxide emissions (line plot f) would overestimate ambient sulfur dioxide concentrations and impacts on AQRVs assuming meteorological and dispersion models are robust.

In sum, ambient sulfur dioxide at sites of monitors reflects sulfur dioxide actually emitted by sources, including EGUs. Line plots in figures 1 and 2 illustrate that modeling maximum, or peak, emissions rates for respective EGUs at the two permit bubbled EGSs can significantly overestimate ambient concentrations (compare plot b to plot a and plot e to plot d). Modeling time-constant actual emissions rates should respect applicable permit operating constraints.

Line plots in figures 1 and 2 also illustrate that modeling each EGU's current-period (2000-01) maximum 3-hour (plots a, b and b') and 24-hour (plots d and e) sulfur dioxide emissions rates would not reflect actual effect of emissions on ambient sulfur dioxide concentrations because the maximum rates do not occur in synchrony. In other words, modeling maximum or peak short-term emissions rates can cause excessive positive bias in modeled concentrations. This is so because we have shown that model-estimated concentrations contain a positive bias [4] when using annual sulfur dioxide emissions averaged during operating hours (plot h). (See *Responses to Recurring Issues*, Part 5.) Bias in modeled concentrations crosses to modeled changes in concentrations. [5] So figures 1 and 2 demonstrate that modeling maximum or peak emissions rates without regard to bias in model-estimated concentrations [6] can significantly distort technical and administrative conclusions in NAAQS and PSD increment compliance assessments and AQRV exposure-impact assessments.

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[3] See oral testimony of Kevin Golden, EPA Region 8, in *Transcript of Hearing – Before the North Dakota Department of Health*, Vol I, which is Exhibit 48 in the NDDH's hearing docket, page 50. See also oral testimony of Richard Long, EPA, Region 8: "In fact, in the early part of the [2000-01] discussions with the North Dakota Department of Health, it was pointed out that at no point do you have all of the major sources emitting at their maximum emission rate, so it was unreasonable to require the State of North Dakota to, in fact, model all of those at that maximum emission rate." Id., pages 104-105.

[4] Positive bias occurs when model-estimated concentrations are larger than actual ambient concentrations, or when a model overestimates actual ambient concentrations.

[5] See *North Dakota's SO2 PSD Air Quality Modeling Report* at Appendix B to Addendum B.

[6] "The accuracy of model estimates varies with the model used, the type of application, and site specific characteristics." See EPA's *Guideline on Air Quality Models*, which is Appendix W, section 9.1.3.a.

2. Emissions during equipment start-up, shutdown and malfunctions can be significant.

Emissions in excess of permit allowed emission rates can sometimes occur during equipment start-up, shutdown and malfunction. We have reviewed EGS excess emissions reports: excess emissions were reported during 2000 and/or 2001 at the Ottertail – Coyote Station, the Antelope Valley Station and the Minnkota Power – MR Young Station. Note, for example, that line plot b exceeds line plot c in the attached figures.

Section 8.1.2.a of Appendix W (70 FR 68240 (November 9, 2005)) attached to 40 CFR 51 indicates that:

> "For point source applications the load or operating condition that causes maximum ground-level concentrations should be established. As a minimum, the source should be modeled using a design capacity."

Footnote "a" to section 8.1.2.a of Appendix W indicates that:

> "Malfunctions which may result in excess emissions are not considered to be a normal operating condition. They generally should not be considered in determining allowable emissions. However, if the excess emissions are the result of poor maintenance, careless operation, or other preventable conditions, it may be necessary to consider them in determining source impact."

We note that exclusion of emissions during start-up, shutdown and malfunction expands the exclusion of emissions during strikes, retooling, major industrial accidents and other catastrophic occurrences. [7] We also note that modeling design capacity or allowable emissions is inconsistent with the flexibility, or the rebuttable presumption, stated at 45 FR 52718, column 3, which indicates that actual emissions can be used instead of allowable emissions. In addition, 70 FR 39162 addresses dispersion modeling to determine sources subject to BART; column 3 indicates:

> "The emissions estimates used in the models are intended to reflect steady-state operating conditions during periods of high capacity utilization. We do not generally recommend that emissions reflecting periods of start-up, shutdown and malfunction be used, as such emissions rates could produce higher than normal effects ..."

We used all hours of CEM sulfur dioxide emissions, including start-up, shutdown and malfunction, when calculating current-period rule-defined actual emissions for major sources as used in our State and EPA MOU Protocol for modeling PSD short-term increment assessments and for model

[7] See 1990 draft *New Source Review Workshop Manual* at page A.39. This manual is docket document number EPA-HQ-OAR-2006-0888-0007.

performance assessments. We also used all hours of CEM sulfur dioxide emissions, including start-up, shutdown and malfunction, when using concurrent hourly meteorological data. [8]

Omission of all excess emissions from calculation of maximum emission rates is illustrated by recalculating line plot b without 3-hour block averages containing the excess emissions. [9] In the attached figures,

> "plot b' " at 60,865.9 lb/hr omits excess emissions – block averages larger than permit allowed 3-hour rolling averaged emissions – included in line plot b at 72,678.9 lb/hr

In sum, we believe that the proposed new definition for "actual emissions" and the proposed policy standard for emissions data when modeling CAA PSD increment consumption should allow discretionary flexibility to exclude or include emissions during start-up, shutdown, malfunction or catastrophic events as appropriate for a fact-specific modeling scenario.

3. Explanations of modeled results must reflect modeled emissions rates.

EPA proposed a policy standard for a new definition for actual emissions that would apply when evaluating with models changes in ambient short-term air quality, a.k.a. consumption of PSD short-term increments. This standard indicates that available data should produce a reliable, consistent and representative analysis of the change in emissions.

The emissions illustration in figures 1 and 2 used fact-specific CEM sulfur dioxide emissions to express the net modeled EGU sulfur dioxide emissions in context of net time-varying actual CEM emissions (plot i). An underlying fundamental difference between EPA Region 8's net emissions rates (plot g) and the Department's net emissions rates (plot h) needs emphasis. (See, for example, *Responses to Recurring Issues*, section 4.6.)

> For each EGU, EPA Region 8 first computed daily averaged sulfur dioxide emissions using 2000 and 2001 CEM emissions. In step two, it rank sorted those daily averages highest to lowest. In step three, it determined the 90th percentile of those rank-sorted averages; i.e., the highest, second-highest, through the 72nd highest are larger than the 90th percentile.
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> For each EGU, we complied the total CEM sulfur dioxide emissions during the year (all operating hours) and divided that total by the number of operating hours.

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[8] See, for *Responses to Recurring Issues Related to North Dakota's Computer Modeling of Sulfur Dioxide in CAA PSD Class I Areas*, hereafter *Responses to Recurring Issues*, Appendix B. See also *Results of air quality modeling to examine the status of attainment of PSD Class I sulfur dioxide increments*, which is docket document EPA-HQ-OAR-2006-0888-0011.14, section 5.0.

[9] The illustrative analysis removed all 3-hour block averages larger than permit allowed maximum 3-hour running averages. No examination of operating records was conducted to assess validity of malfunctions.

A modeling of all respective EGU's 90th percentile rates not only assumes that all EGUs could emit at respective 90th percentile rates in synchrony but also assumes that all EGUs emit at their respective 90th percentile rates during all hours of modeled meteorology so as to force synchrony of these higher rates during poor meteorological dispersion so as to cause modeled worst-case ambient concentrations. [10] These assumptions also apply when using other representations of actual rates, e.g., maximum or peak emissions rates. (See line plots a, b, b', d and e in figures 1 and 2. As previously noted, these sums of peak rates never occurred.)

Were EPA Region 8's emissions rates and the Department's emissions rates representative of actual emissions and actual ambient concentrations? The net EGU sulfur dioxide emissions rates used by EPA Region 8 and the Department can be expressed as percentiles of actual time-varying CEM emissions (plot i in figures 1 and 2). There are 17,544 hours during years 2000 and 2001, 5,848 back-to-back 3-hour periods and 731 back-to-back 24-hour or daily periods. The CEM sulfur dioxide emissions for each EGU can be averaged for each 3-hour period and each 24-hour period, and the net total for all EGUs for each hour and period can be calculated.

In figure 3 (page 17), we provide a frequency distribution of the 5,484 3-hour block averaged time-varying emissions during 2000-01 reflecting the permit bubbled EGUs at the Antelope Valley Station and the GRE Stanton Station. Line plot b in figures 1 and 2 is the H sum of these 3-hour averages.

For example, the net total emissions rates for 43 of the 17,544 hours were larger than Region 8's modeled total EGU rates at 47,344 lb/hr, and the net total emissions rates for 10 of 5,848 3-hour periods were larger than 47,344 lb/hr. No net total emissions rates for the 731 24-hour periods were larger than 47,344 lb/hr. Ratios of these data, e.g., 10 divided by 17,544, represent the chances (probability) that actual same-time emissions were larger than modeled net total emissions. Conversion of these data to inverse percentiles (e.g., (17,544–10)/17,544) is shown in table 1.

In sum, figures 1, 2 and 3 illustrate that maximum or peak sulfur dioxide emissions rates for respective EGSs/EGUs would not be representative of the sulfur dioxide actually emitted. EPA Region 8 has expressed its chosen sulfur dioxide emissions rates for its draft 2003 modeling as 90th percentiles of 24-hour (daily) averages of emissions so as to appear consistent with its guidance. [11] The sum of Region 8's sulfur dioxide emissions rates of EGUs, as well as the sum of our annual averaged emissions rates, are less than the absolute highest sum of CEM emissions for all hours during years 2000 and 2001 (plot f in figures 1 and 2). As shown in table 1, 99.8 % of hourly CEM emissions are less than Region 8's modeled emissions rates and 73.7 % are less than our modeled emissions rates. Yet our modeled emissions rates resulted in a positive bias in model-estimated ambient concentrations. (See also section 4 below.)

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[10] See *Responses to Recurring Issues*, page 32, which quotes a 1999 EPA Region 8 letter.

[11] See EPA's 1990 draft *New Source Review Workshop Manual* at pages C.48 and C.49.

Table 1. Comparison of EPA R8 and NDDH EGU SO2 Emission Rates		
	EPA R8	NDDH
Modeled net EGU SO2 rate (lb/hr)		
90th percentile of daily averaged hourly CEM emssions	47,344.0	
rule-defined "actual emissions"		38,472.5
Percentile of compiled SO2 rates		
1-hour, all EGUs *	99.8	73.7
3-hour, bubbled EGS *	99.8	73.8
24-hour, bubbled EGS *	100.0	75.4
24-hour, sum of respective EGU daily rates **	90.2	54.9
* consecutive block (1-hour, 3-hour or 24-hour) total CEM emissions		
** each EGU's daily average CEM emissions ranked high to low, then ranked daily averages for all EGUs are summed		

4. Bias in model-estimated cumulative concentrations and changes in cumulative concentrations has two dimensions.

Our periodic review sulfur dioxide emissions inventories included minor and major stationary sources (see table 2). These inventories did not include mobile and area sources. In section 3 above, we illustrated with fact specific examples that EGU sulfur dioxide short-term emissions rates used in modeling for estimating concentrations must reflect sulfur dioxide actually emitted (under an assumption that models are adequately robust). In section 1 above, we illustrated with fact specific examples that EGU maximum short-term sulfur dioxide emissions rates never occur in synchrony.

Table 2 lists the source categories and sources included in our periodic review modeling of PSD increment consumption. Our model performance testing used only current emissions and meteorology. (See *Responses to Recurring Issues*, section 5.1.) As we have noted, model-estimated concentrations from a modeling of current annual sulfur dioxide emissions averaged during operating hours contain a positive bias.

Table 2. Diversity of the state's sources of sulfur dioxide emissions.

Source Category	Current Period	Baseline Period
Minor sources * --		
oil production flares & treaters	numerous	numerous
Major sources ** --		
oil refineries	1	2
charcoal briquetting plant	0	1
sour natural gas processing plants		
ceased operation after MSBD		2
began operation after MSBD	2	
synfuels plant	1	0
electrical generating units		
ceased operation after MSBD		7
operating during both periods	7	7
began operation after MSBD	6	

* See State-EPA MOU Protocol, page 53.
** See Responses to Recurring Issues, table 2.
MSBD = westen North Dakota's minor source baseline date

However, distortions of bias in model-estimated source-cumulative, short-term concentrations used for NAAQS compliance assessments and AQRV impact assessments can occur via inconsistent statistical expressions (e.g., maximum, peak or average) of emissions rates among sources. For example, a use of maximum or peak rates for some EGUs and average rates for other EGUs and sources would cause an imbalance of impact on the estimated concentrations because maximum or peak rates are larger than average rates.

Distortions of bias in model-estimated source-cumulative, short-term changes in concentrations used for PSD increment-consumption assessments can also occur via inconsistent statistical expressions (e.g., maximum, peak or average) of emissions rates among sources. For example, a use of maximum or peak rates for EGUs operating during a current period, but not during a baseline period, and average rates for EGUs operating during a baseline period, but not during a current period, would cause an imbalance of impact between increment consuming and increment expanding emissions, respectively, on the estimated changes in concentrations.

We modeled both inventories. Modeling the current inventory provided cumulative concentrations, which allowed us to examine bias and error in model-estimated concentrations. Finally, we subtracted model-estimated concentrations using the baseline inventory from model-estimated concentrations using the current inventory to determine changes in concentrations for PSD increment consumption assessment.

In sum, some sources were operating during the current period but not during the baseline period; the current emissions of these sources are increment consuming. And some sources were operating during the baseline period and not during the current period; the baseline emissions of these sources are increment expanding. So modeling only increment-affecting (increment consuming and increment expanding) emissions does not avoid the bias and error in model-estimated concentrations because bias and error also occurs in model-estimated changes in concentrations.

5. Good judgement in the "Actual Emissions Rates Used to Model Short-Term Increment Compliance" is necessary.

In its preamble for the proposed rule revisions, EPA provides several reasons for the proposed policy standard contained in the new definition for actual emissions at 40 CFR 51.166(f)(1)(iii). (See 72 FR 31389 and 31390.) The Department's PSD SIP periodic review and EPA Region 8's draft modeling are case and fact specific examples that justify those reasons.

1) "[T]here is often not sufficient data available to determine the maximum short-term emissions rate over a 2-year period." (See 72 FR 31389, column 3.)

We included the emissions of oil production flaring at wells and treaters in our CAA PSD periodic review. (See *Responses to Recurring Issues*, sections 4.7 through 4.9.) Many of these sources operated for periods less than two years prior to and during PSD baseline because the State encouraged sour natural gas recovery. (Id., section 4.9.) So there are no practical methods to estimate representative sulfur dioxide emissions for these sources for a full two-year period.

2) "[T]he modeled change in concentration may be overly conservative when increment consumption modeling is based on maximum emission rates from all sources that consume increment." (See 72 FR 31390, column 1.)

As illustrated with figures 1, 2 and 3 which are discussed above, it indeed is not reasonable to expect that, in all modeling, increment-consuming sources will all be operating at their maximum short-term emissions rates in synchrony. When maximum short-term emission rates of major sources do not occur in synchrony, modeling these rates would not represent actual concentrations due to the large differences between these rates and the actual time variable rates. (See *Responses to Recurring Issues*, Summary at paragraphs S3 on pages xi through xiv, section 4.6, and sections 5.5 through 5.12.) Given EPA Region 8's current-period (2000-01) emissions for its draft 2003 modeling were substantially larger than the Department's current-period emissions, bias in modeled concentrations using its emissions rates would have been much larger than bias using the Department's rates. (Id., sections 4.6, 5.6, 8.8 and 8.9.)

3) "Since it may be unusual for all increment consuming sources to all be operating at their maximum emissions rates at the same time, we believe that 'administrative good sense' dictates that we permit average emissions rates to be used as well." (See 72 FR 31390, column 1.) "In many cases, combining the average emissions rates of all increment consuming sources in an emission

inventory may produce a more representative picture of the degree of change in short-term pollution concentration over time." (Id., column 2.)

We have demonstrated that use of annual sulfur dioxide emissions averaged during operating hours overestimated actual ambient concentrations, rather than underestimated these concentrations. We have also demonstrated that the positive bias in model-estimated concentrations when using sulfur dioxide emissions averaged during operating hours was comparable to and not significantly different than that bias when modeling same-time hourly CEM sulfur dioxide emissions and meteorology. (See *Responses to Recurring Issues*, Appendix B.) The reasons for this outcome likely include the large distances between major sources and PSD class I areas, [12] time variable actual emissions and time variable dispersion such as winds, [13] the stochastic dispersion in the atmospheric boundary layer [14] and the less than robust physics of the Calmet and Calpuff models. [15] (See also figures 1 and 2 attached and *Responses to Recurring Issues*, section 4.3, Part 5 including sections 5.8 and 5.12, and section 6.4.)

4) "A more representative indication of the change in emissions is produced by using a consistent set of data." "Fairness also dictates that we allow use of average short-term emissions rates and not require use of maximum emissions rates in all cases. If maximum emissions rates may be used when data are available but averages are used when the data are insufficient, the analysis may be biased against the sources that have maximum emissions rate data." (See 72 FR 31390, column 2.)

In North Dakota, our current period sulfur dioxide emissions inventory includes stationary sources constructed after the minor source baseline date and stationary sources that were also operating during PSD baseline (see section 4 and table 2). The baseline inventory includes stationary sources that either (1) subsequently ceased operation prior to the current period, (2) decreased emissions or

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[12] See *Responses to Recurring Issues* at figure 1 (page 3). Most major sources, such as EGUs, are located more than 90 km from North Dakota's PSD class I areas and are scattered in a region having an axis of about 90 km from Beulah to Mandan.

[13] In the North Dakota modeling domain, the maximum short-term emissions of major sources do not occur in synchrony as demonstrated in section 1 of this paper. And major sources are widely separated in horizontal, vertical and time varying meteorology. A source's maximum or peak emissions rate seldom occurs in synchrony with poor dispersion meteorology (i.e., causing high ambient concentrations) that also transports that source's emissions over a class I area. As evidence that this is so, ambient sulfur dioxide hourly concentrations at sites of monitors in the North and South Units of Theodore Roosevelt National Park are less than the lowest reliable calibrated level of the monitors (1.5 or 2 ppb) more that 80-85 % of all hours in a year. (See Appendices A and B of Addendum C (Protocol Results Report) to *North Dakota's SO2 PSD Air Quality Modeling Report*, which is EPA docket document EPA-HQ-OAR-2006-0888-0011.14.)

[14] See *Responses to Recurring Issues* at figures 8 (page10), A2 (page 121) and A3 (page 122). Data in these figures illustrate that ground-level ambient concentrations are independent, or not proportional, to wind speed, although dilution of emissions at stock top is proportional to wind speed.

[15] For example, the Calpuff model uses the Heffter time-dependent physics for dispersion after initial Gaussian dispersion of a pollutant, which were also dispersion methods used in the late 1970s and early 1980s in the Mesopuff model.

(3) increased emissions. (See *Responses to Recurring Issues*, table 2, pages 34-35.) Both inventories also included numerous minor sources, which were oil and gas production flares and treaters.

The Department has illustrated several ways in which choices in current-period and PSD baseline sulfur dioxide emissions inventories can distort and exaggerate the outcome of modeling on PSD increment consumption. (See sections 1, 2 and 4 above. See also *Responses to Recurring Issues*, Part 4 and section 8.2.) In addition, EPA Region 8 apparently did not consider the bubble permit constraints on sulfur dioxide emissions in its calculations of 90th percentiles of daily averaged CEM sulfur dioxide emissions because no mention is made of the bubble constraints in its draft 2002 and 2003 modeling reports. (See docket document EPA-HQ-OAR-2006-0888-0607.3.)

6. An Essay: Bias in modeled concentrations is not a trivial issue.

Inputs to air quality models that are conservative so as to cause larger estimates of concentrations usually have no impact on permitting or air quality management strategic actions when the model-estimated concentrations indicated compliance with a NAAQS or PSD increment. But the excess conservatism in an air quality screening analysis is occasionally replaced with a less conservative refined analysis, especially when model-estimated concentrations approach or exceed a NAAQS or PSD increment, so as to improve the accuracy of the estimated concentrations. [16] This, in fact, was the Department's objective for its periodic review subsequent to its 1999 draft Minnkota Report. [17]

Excess conservatism in modeling leads to higher costs in emissions controls when modeled outcome enters compliance strategies. And models are not only used to assess compliance with NAAQS, PSD increments and impacts on AQRVs, but also to evaluate air quality management and source design strategies under what-if scenarios. Although there is no bright line or threshold separating

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[16] "An air quality analysis should begin with a screening model to determine the potential of the proposed source or control strategy to violate the PSD increment or NAAQS." (See Appendix W, section 10.2.1.b.) "If the concentration estimates for the screening techniques indicate a significant impact or that the PSD increment or NAAQS may be approached or exceeded, then a more refined modeling analysis is appropriate ..." (Id., section 10.2.1.c.)

[17] See draft *Calpuff Class I Area Analysis for the Milton R. Young Generating Station*, which is docket document EPA-HQ-OAR-2006-0888- 607.2. The current-period emissions in this report were permit allowed emissions rather than actual emissions per 45FR, 52718, col.3. (See the NDDH's *Evaluation of 'EPA Comments on NDDoH's Proposed Determination Regarding the Adequacy of the DIP to Protect PSD Increment for Sulfur Dioxide'*, which is Exhibit 82 in the NDDH's hearing docket, figure 2.) Related correspondence occurred during years 2000 and 2001 between the Department and EPA Region 8. For example, "In our January 10, 2001 meeting, you explained that the State needs to refine it previous [Minnkota] analysis before you could determine the appropriate control strategy to address the [increment] violations. ... We acknowledge that the State needs to refine the modeling analysis ..." (See letter dated March 28, 2001, by Richard Long, EPA, to Francis Schwindt, NDDH, which is Exhibit 131 in the NDDH's hearings docket. See also oral testimony of Mr. Long at *Transcript of Hearing – Before the North Dakota Department of Health*, Vol. I, which is Exhibit 48 in the NDDH's hearings docket, pages 59 and 60.)

unacceptable, inappropriate performance of meteorological and dispersion models from acceptable, appropriate performance, bias in modeled concentrations matters, and bias that is not acknowledged and unknown can have a reaching consequence.

Furthermore, choices for emissions rates for a source at current time and at PSD baseline and between sources in these inventories, including inconsistency in those choices, can occur due to the historically strong emphasis to model the plausible, but generally improbable, worst-case outcome or to using the models in a better-to-be-safe-than-sorry approach to assure compliance with NAAQS or PSD increments. [18] This approach can cause unknown and excess bias in model estimates of concentrations. Comments in docket EPA-HQ-OAR-2006-0888 regarding maximum emissions rates [19] are clear examples.

Bias in modeled concentrations is due to uncertainty in most model input data and inaccuracy in model algorithms. Our comments focus on emissions data with case-specific and fact-specific examples. These and other comments in docket EPA-HQ-OAR-2006-0888 illustrate there has been no perfect, universal approach to calculating emissions for modeling. In our scenario, we wondered during 2000-01 whether an 85th or 80th percentile rather than EPA Region 8's 90th percentile would be more representative of the sulfur dioxide actually emitted. As explained in our period review report [20] and in our comments to this proposed rule making, we followed rule-defined "actual emissions", which is near the 75th percentile of daily averages of emitted sulfur dioxide (see figure 3 and table 1).

We are not aware of an emissions paradigm, such as an emissions hierarchy, [21] that – 30 years after adoption of PSD in the CAA and 29 years after the first *Guideline on Air Quality Models* – entirely avoids the bias issue or assures a reasonable, positive bias. Reviewing authorities presently use a variety of approaches, seemingly lacking consistency, when assessing changes in ambient concentrations by modeling emissions or changes in emissions. [22] No doubt, professional judgement and flexibility is an existing element in these assessments, and so EPA's proposed new definition is not a new approach for conducting such assessments.

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[18] Unlike other federal environmental protection programs, compliance assessments for the primary NAAQS, which are anchored to criteria documents, and the PSD increments have not followed exposure risk-based methods.

[19] See supra footnote 1.

[20] See *North Dakota's SO2 PSD Air Quality Modeling Report*, section 4.2

[21] See PSD Modeling Workgroup's issues summary, comprising EPA, other federal agency and state modelers, dated May 17, 2005, focus issues 22 and 23, available at http://cleanairinfo.com/modelingworkshop/presentations/PSD_WG_Coulter.pdf. Presumably the workgroup has not resolved issues 22 and 23, since the preamble's discussion does not provide a hierarchy for emissions rates for PSD modeling.

[22] See docket document EPA-HQ-OAR-2006-0888-587.4 titled PSD Questionnaire Summary dated May 16, 2005, at responses to questions Q7f, G7i, Q7k, Q7l, Q7n, Q9a, Q9b, Q9c, Q12, Q15 and Q16.

Like WESTAR, [23] we believe that our case-specific facts illustrate the most appropriate option in a hierarchy for calculating emissions for modeling would:

- ✓ conform to the Clean Air Act, federal PSD rule, and state law and rule, and other applicable laws and rules;
- ✓ minimize the error and bias (maximize the accuracy) in model-estimated concentrations for a reliable, best-fit reflecting the actual status of ambient air quality;
- ✓ be consistent for those sources in both the current and the baseline emissions inventories – i.e., emissions are supported by data available, represent amounts actually emitted, and are "apples to apples" (avoid distorting ambient impact of one source or group of sources over another);
- ✓ be fair and consistent among all sources in either the current or the baseline emissions inventories and among source types – i.e., emissions are "apples to apples", and
- ✓ not confound dispersion model performance analyses for bias and error by using emissions that are not "apples to apples".

We support EPA's proposed policy standard that emissions rates for modeling changes in ambient air quality, which are compared to PSD increments, are reliable, consistent and representative. Consistency is two dimensional – between current period and a baseline among sources within a source category and between source categories. (See *Responses to Recurring Issues*, page 24.) Representative also has two dimensions – representative of normal emissions and representative of actual ambient concentrations. In these comments, we have factually illustrated that modeled sulfur dioxide emissions rates can be statistically reliable, but not statistically representative of actual time-variable emissions and, therefore, not representative of actual ambient concentrations.

In our PSD periodic review modeling and in our initial comments, we demonstrated that bias in model-estimated sulfur dioxide concentrations using annual sulfur dioxide emissions averaged during operating hours is positive. We also demonstrated that the positive bias in model-estimated concentrations when using the average sulfur dioxide emissions rates was comparable to and not significantly different than that bias when modeling same-time hourly CEM sulfur dioxide emissions and meteorology. Therefore, a use of larger time-constant emissions rates as described in these comments and in our initial comments would result in unreasonable, excess bias in model-estimates of ambient concentrations in our modeling domain. The facts in our comments demonstrate that any hierarchy for emissions in modeling would be incomplete without inclusion of a principle that model inputs and model-estimated concentrations must be held to earth.

Emphasis on modeling maximum or peak emissions rates, such as EPA's draft *1990 New Source Review Workshop Manual* (pages C.48 and C.49), and emphasis on model performance testing, such as its *Guideline on Air Quality Models* (section 9.1.3) and other EPA documents, seem contradictory without also embracing bias correction. A modeling of maximum emissions rates not only assumes that all sources could emit at respective maximum rates in synchrony but also assumes that all sources emit at their respective maximum rates during all hours of modeled meteorology so as to force synchrony of these higher rates during poor meteorological dispersion so as to cause modeled

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[23] See , WESTAR's *Recommendations for Improving the Prevention of Significant Deterioration Program* dated May 2005, which is docket document EPA-HQ-OAR-2006-0888-0002.1, page 8.

worst-case ambient concentrations. [24] It seems that the worst-case, but unlikely result, approach has overshadowed the best estimate, most-likely result, approach. When error in model-estimated concentrations is similar to or greater than a PSD increment, e.g., the sulfur dioxide PSD class I 24-hour increment of 5 ug/m3, whether or not changes in model-estimated concentrations from baseline to current time exceed the increment, the credibility of those estimated concentrations or estimated changes in concentrations for air quality management decision making becomes doubtful. [25]

And excess bias in modeled concentrations caused by data inputs obscures the relative performance accuracy of model physics and algorithms. "The reader [of Appendix W] should be aware that statements on model accuracy and uncertainty may imply the need for improvements in model performance that even the 'perfect' model could not satisfy." [26]

The better alternative is to assure that the modeled concentrations are credible through case-specific and fact-specific model performance uncertainty and accuracy analyses that compare modeled to monitored concentrations before assessing the implications of the concentrations in air quality management. This is consistent with long-standing (since the late 1970s) provisions of the CAA and decisions of courts and a long-standing (since the late 1970s) recommendation in EPA published literature for model performance testing. [27] "In all applications of models an effort is encouraged to identify the reliability of the model estimates for that particular area and to determine the magnitude and sources of error associated with the use of the model." [28]

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[24] See also *Responses to Recurring Issues*, paragraphs S4.1, S4.3 and S4.4, pages xiv-xvi.

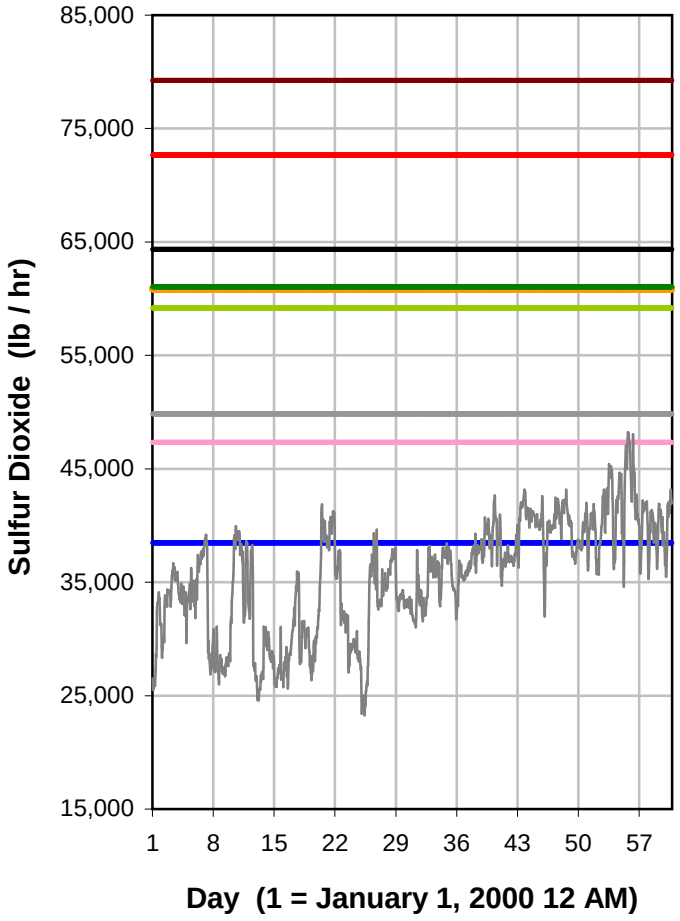
[25] See *Responses to Recurring Issues* at section 5.8 (table 8) and *North Dakota's SO2 PSD Air Quality Modeling Report* at Addendum C (MOU *Protocol Results Report*), which is docket document EPA-HQ-OAR-2006-0888-0011.14, section 10.1.

[26] See EPA's *Guideline on Air Quality Models*, which is Appendix W, section 9.1.1c. See also *Responses to Recurring Issues* at sections 3.5, 3.6 and 3.7.

[27] See, for example, *Responses to Recurring Issues* at sections 3.6, 3.7 and 5.1 and Appendix W at section 9.1.3.

[28] See Appendix W at section 9.1.3.b.

CEM Sulfur Dioxide Emissions
for the months of January 2000 through February 2000
-- all North Dakota coal-fired electric utilities --



Graph legend for line plots sequentially starting at the top

- plot a at 79,246.7 lb/hr = sum of highest (H) 3-hr block averaged CEM SO2 emissions for 13 EGUs
- plot b at 72,678.9 lb/hr = bubble adjusted sum of H 3-hr block averaged CEM SO2 emissions for 7 EGSs
- plot c at 64,339 lb/hr = sum of maximum 3-hr rolling average SO2 emissions allowed by operating permits
- plot b' at 60,865.9 lb/hr = omits excess SO2 emissions over permit allowed emissions for 7 EGSs
- plot d at 61,050.1 lb/hr = sum of H 24-hr block averaged CEM SO2 emissions for 13 EGUs
- plot e at 59,173.3 lb/hr = bubble adjusted sum of the H 24-hr block averaged CEM SO2 emissions for 7 EGSs
- plot f at 49,832.9 lb/hr = highest sum of CEM hourly SO2 emissions by 13 EGU's during 2000-01
- plot g at 47,344 lb/hr = sum of 90th percentile of daily averaged CEM SO2 as used by EPA R8
- plot h at 38,472.5 lb/hr = sum of SO2 rule-defined 'actual emissions' as used by NDDH
- plot i = sum of CEM SO2 emissions by 13 EGUs for each hour

Figure 1.

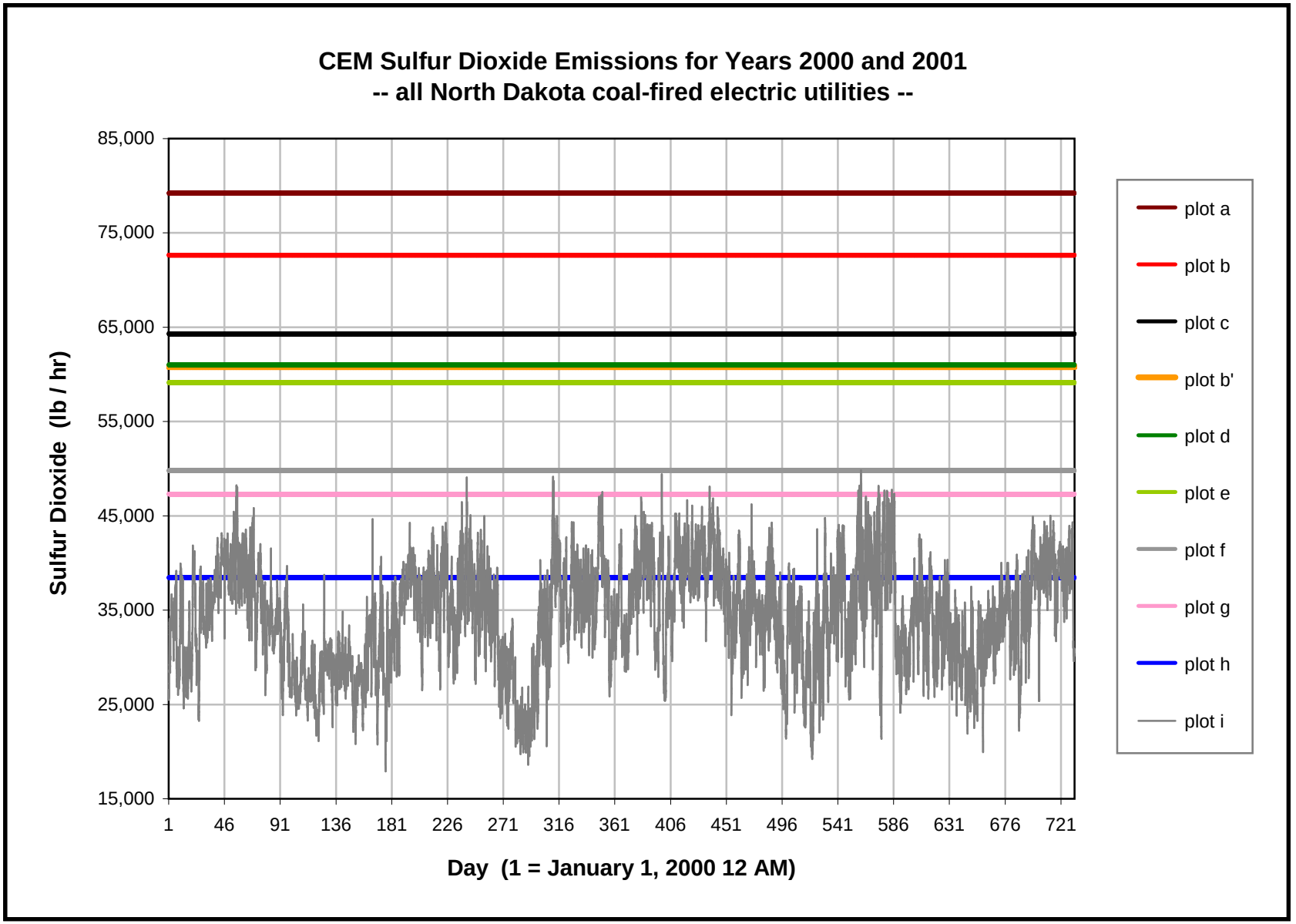


Figure 2. (For legend detail, see figure 1.)

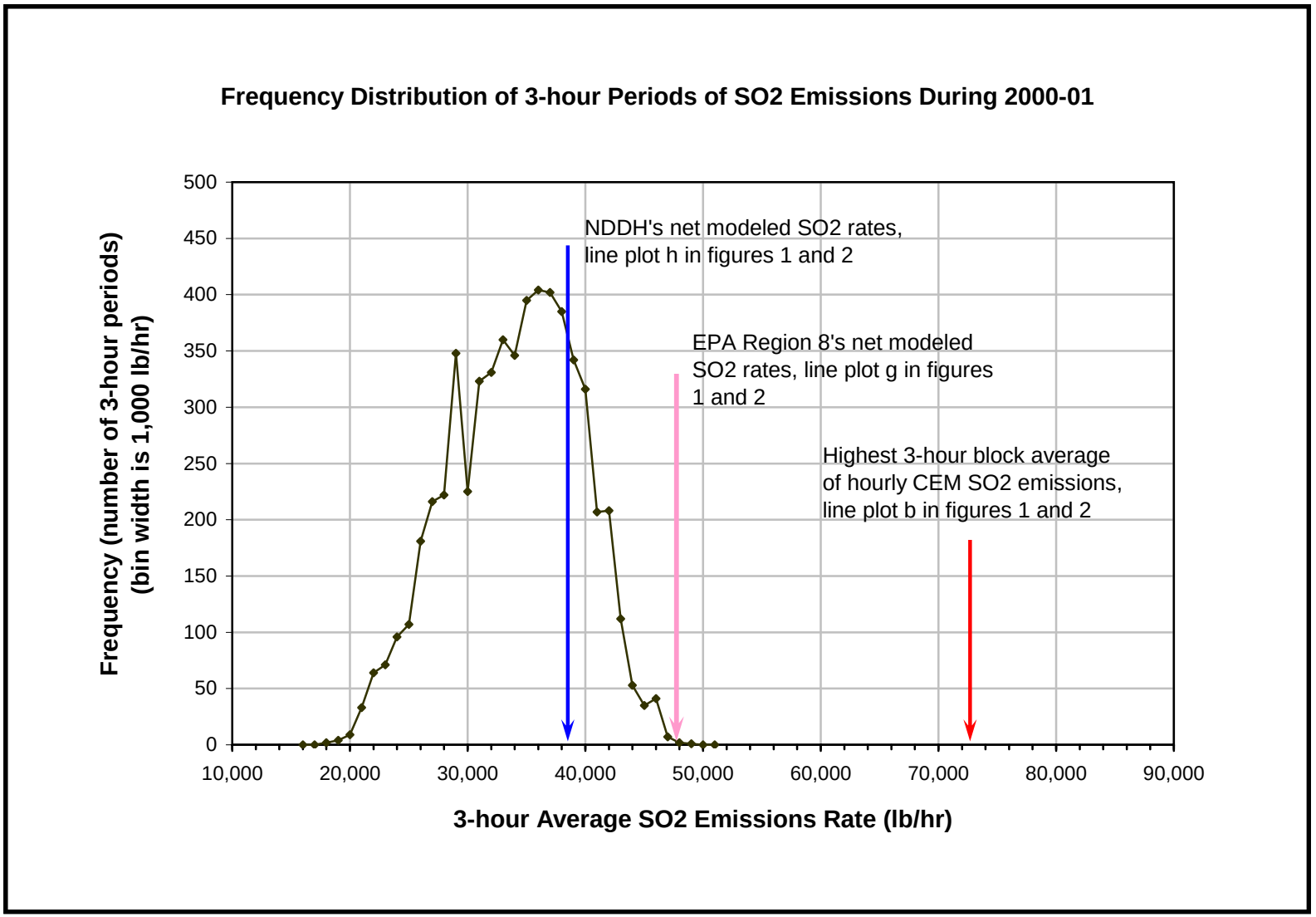

Frequency Distribution of 3-hour Periods of SO2 Emissions During 2000-01
Frequency (number of 3-hour periods)
(bin width is 1,000 lb/hr)
500
450
400
350
300
250
200
150
100
50
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
80,000
90,000
3-hour Average SO2 Emissions Rate (lb/hr)
NDDH's net modeled SO2 rates, line plot h in figures 1 and 2
EPA Region 8's net modeled SO2 rates, line plot g in figures 1 and 2
Highest 3-hour block average of hourly CEM SO2 emissions, line plot b in figures 1 and 2

Figure 3.